

Update on NOAA's National Weather Service (NWS)  
WSR-88D Level II Data Collection and Distribution Network

Updated 2 March 2007

**PURPOSE:**

This summary updates Weather Surveillance Radar-1988, Doppler (WSR-88D) Level II data users, real-time and archive, of WSR-88D changes which may impact data format, data reliability, and data quality. This replaces the update of 26 February 2007. **This update provides the URL for the Build 9 Beta Test training page.**

**PLANNED CHANGES:**

Additional WSR-88D Level II Connections. The NWS plans to add the FAA WSR-88D system at San Juan, Puerto Rico (TJUA) to the Level II Data Collection and Distribution Network during the Beta Test of RPG Build 9 in March 2007. No FAA Level II data can be added to the network until Build 9 software and hardware are installed on the FAA WSR-88D systems. At this time, other than the addition of the San Juan WSR-88D, Level II data from no other radars is expected to be added to the network. The list of sites on the network is listed at: [http://www.roc.noaa.gov/NWS\\_Level\\_2/](http://www.roc.noaa.gov/NWS_Level_2/).

Build 9: Deployment of RPG and RDA Build 9 software and hardware (RPG and Base Data Distribution System) for Beta Test and use period beginning in March 2007 is being planned. The beta test schedule is as follows:

Week of March 5	Norman/Oklahoma City, OK (KTLX)
Week of March 12	Des Moines, IA (KDMX)
Week of March 19	Yuma, AZ (KYUX)
Week of March 26	San Juan, PR (TJUA)
Week of April 9	Albuquerque, NM (KABX)
Week of April 16	Beale AFB, CA (KBBX)

The Oklahoma City Weather Forecast Office (WFO) will be able to execute any volume coverage pattern (VCP) needed to support operations when the radar is returned to service with Build 9 operating, estimated to be the afternoon of 6 March. The Radar Operations Center test team will perform a Basic Functionality test as part of the Beta Test at the Oklahoma City WFO Beta Test. During this test the KTLX WSR-88D will complete two volume scans for each of the three new VCPs. The Basic Functionality Test is expected to take place beginning at 9 am (Central) on 7 March, weather permitting. This might be a good opportunity to check how your software processes the data from these new VCPs. The ROC test team will coordinate with the WFO to issue a Free Text Message shortly before starting the Basic Functionality Test so you can monitor the test in real time if desired.

Software release to the field is scheduled to begin in late May 2007 and will continue for about 6 months. Beginning in May, the release schedule of Build 9 kits to field sites will be at: <http://www.roc.noaa.gov/ssb/sysdoc/techman/subs/moddocs.asp?param=heading&data=MODIFICATION+NOTES> (look under Modification Note 95). Please note, this is a revised URL from the one posted in the January 2007 Level II update. The software will be shipped to sites as a kit which will also include a new RPG LINUX-based processor. The format and content of the Level II data stream should be unchanged except as described below.

Addition of the SZ-2 (Sachidananda – Zrnica) Algorithm. Range ambiguity can occur when a returned signal may be associated with one of several pulses transmitted prior to the latest pulse. The SZ-2 Algorithm will provide a new range unfolding technique to reduce the effects of the range-velocity ambiguity that exists with Doppler weather radars and should result in fewer areas of range folded data, sometimes referred to as “purple haze.” This algorithm will provide users a cleaner, more complete view of the Doppler data by correctly unfolding overlaid targets. Figures 1 and 2, below, contain examples of the reduced range folding the SZ-2 algorithm provided during tests.

**New VCPs have been developed to add SZ-2 products and Level II data to the system. The VCP numbers will be 211, 212, and 221 and will use the same elevation angles as used in VCPs 11, 12, and 21, respectively.** The SZ-2 algorithm only runs during the “split cuts” for VCPs 11, 12, and 21 (elevation angles of 1.5° or lower). External systems may need modification to recognize the new VCPs. **Please note: VCPs 11, 12, and 21 will remain in the system. VCPs 211, 212, and 221 are NEW VCPs THAT WILL BE ADDED TO THE SYSTEM.** Below is a table summarizing the legacy VCPs 11, 12, and 21 and their SZ-2 counterpart:

<b>Current VCPs</b>	<b>SZ-2 VCPs TO BE ADDED</b>
<b>11:</b> 14 elevations in 5 minutes, all available PRFs	<b>211:</b> 14 elevations in 5 minutes, PRF 8 (117 km)
<b>12:</b> 14 elevations in 4.5 minutes, all available PRFs	<b>212:</b> 14 elevations in 4.8 minutes, PRF 6 (137 km)
<b>21:</b> 9 elevations in 6 minutes, all available PRFS	<b>221:</b> 9 elevations in 6 minutes, PRF 5 (147 km)
	Notes: <ol style="list-style-type: none"> <li>1. Same elevation angles used.</li> <li>2. Same volume scan durations, except VCP 212 runs slightly longer (~20 s) than VCP12.</li> <li>3. The above ranges are the range to the end of the first trip/unambiguous range.</li> </ol>

A summary of the VCPs as of Build 9 is in Table 1 at the end of this update.

**Build 10:** Deployment of RPG and RDA Build 10 software is planned for a Beta Test and use period beginning in January 2008. Software release to the field is scheduled to begin in April 2008. There are two major changes in Build 10 that will impact Level II users.

1. The format of the Level II data will be changed. This change is necessary to enable the potential collection of Super Resolution (Build 10) and dual polarization (Build 11) Level II data. The Radar Operations Center/NWS will make the following tools available to aid Level II users:
  - a. Draft interface control documents (ICDs) describing the new data format by 31 March 2007. An announcement of the availability of the ICDs and sample data sets will be sent to users and posted on the Level II web site: [http://www.roc.noaa.gov/NWS\\_Level\\_2/](http://www.roc.noaa.gov/NWS_Level_2/) in the area labeled as “Build 10 Changes.”
  - b. Sample archive data sets using the new format by 30 June 2007.
  - c. Sample real-time data streams (LDM and BIZIP2 compression) using the new format by 31 August 2007. Times when the data are going to be transmitted from the Radar Operations Center test bed WSR-88D will be posted on the Level II web site: [http://www.roc.noaa.gov/NWS\\_Level\\_2/](http://www.roc.noaa.gov/NWS_Level_2/) in the area labeled as “Build 10 Changes.”
  - d. An early version of Build 10 software, executable and source code at the Common Operations and Development Environment (CODE) web site: <http://www.weather.gov/code88d/> by 31 August 2007. The software will contain code to read super resolution data and to recombine the super resolution data into legacy resolution data. The RPG algorithms and 4-bit base products will use recombined data.
2. The spatial resolution of the Level II data will be changed. On the “split cuts” those scans at or below 1.5°, Super Resolution data will be provided. Note, VCP31 has a “split cut” at the 2.5° scan, thus Super Resolution data will be available at that scan too. The range gates for reflectivity data will decrease from 1 km to 250 m. The azimuthal resolution of all three moments of data will change from 1° to 0.5°. In addition, the Doppler data range will be extended from 230 km to 300 km. An example of how the reflectivity and radial velocity data can look with the Super Resolution is shown in Figure 3.
3. The NWS is investigating how to implement Level II collection of Super Resolution data. The Super Resolution data will require more than the allotted 128 kbps bandwidth and funding may not be available initially to expand the

bandwidth. We will make this analysis available to Level II users when it becomes available later in the year.

Dual Polarization: Deployment of the dual polarization hardware/capability and Build 11 is planned to begin in late 2009 after a beta test earlier in 2009. The deployment will likely take over two years. The timing of the addition of dual polarized data to the Level II data stream will be dependent on when funding for increased bandwidth becomes available.

#### ADDITIONAL INFORMATION:

Users who use CODE (Common Operations and Development Environment) to process level 2 data can update to Build 8, available at <http://weather.gov/code88d/>. The Build 9 RPG software should be available in May 2007. However, definition files for the new Build 9 VCPs and instructions to use them with Build 8 CODE software have been posted on the CODE web site.

Warning Decision Training Branch (WDTB) training materials prepared for WSR-88D NEXRAD agency operators can be found in the Build Updates section at: <http://www.wdtb.noaa.gov/>. The Beta Test version of the ORDA/RPG Build 9 training materials are available at: <http://www.wdtb.noaa.gov/buildTraining/Build9/index.html>. The training material will likely be modified, based on field experience during the Build 9 Beta Test, before the final version is released when network-wide deployment of Build 9 begins in May 2007.

NWS-Maintained Level II Status Monitoring Site: The following web site provides the status of Level II data flow to the NWS Telecommunications Operations Center: <http://weather.noaa.gov/monitor/radar2/>. The site contains a color-coded display of sites on the Level II network by NWS region. The colors help the user differentiate between sites with just a Level II outage and sites with both Level II and III outages (implying the radar is inoperable). In addition, users can click on the site of interest and view any applicable Operator Notes/Recent Free Text Messages which provide more information on the radar's status. Information on apparent data latencies is also provided.

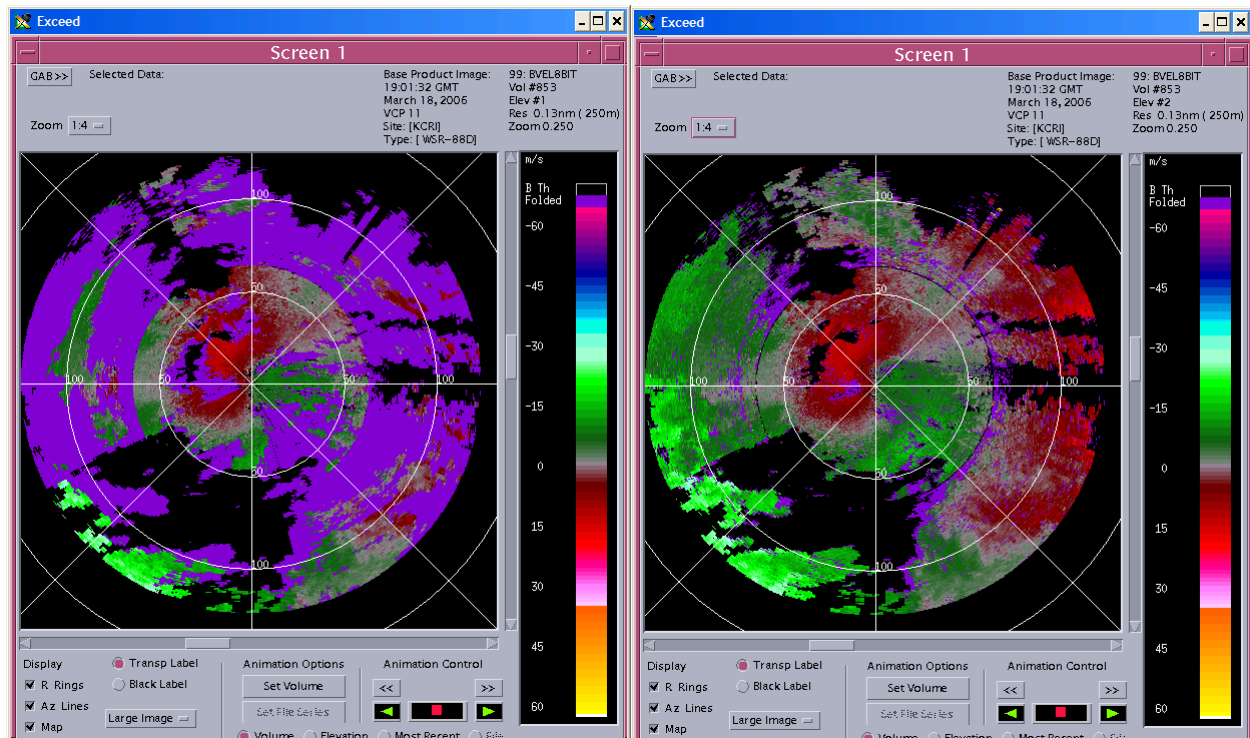
The Radar Operations Center (ROC) has a URL (<http://www.roc.noaa.gov/ops/ssm.asp>) for users to obtain:

1. A list of sites and which RPG software build the site is using, and
2. A list of sites and which volume coverage pattern the site is using, during the last automated hourly ROC call to the RPG.

Additional information about the Level II network and the paper, An Update on the NWS WSR-88D Level II Data Collection and Distribution Network and Plans for Changes, presented at the January American Meteorological Society Interactive Information Processing Systems (IIPS) Conference are available at: [http://www.roc.noaa.gov/NWS\\_Level\\_2/](http://www.roc.noaa.gov/NWS_Level_2/). The briefing slides used at the January Family of Services meeting are also available at this web site.

The Office of the Federal Coordinator for Meteorology has posted all four updated parts of Federal Meteorological Handbook No. 11 – Doppler Radar Meteorological Observations (WSR-88D) (FMH-11). Part A is updated to software Build 8. Parts B – D are updated to software Build 6. The Radar Operations Center intends to update Parts A and C to Build 9 this spring. The FMH-11 documents can be downloaded from:  
<http://www.ofcm.gov/homepage/text/pubs.htm>.

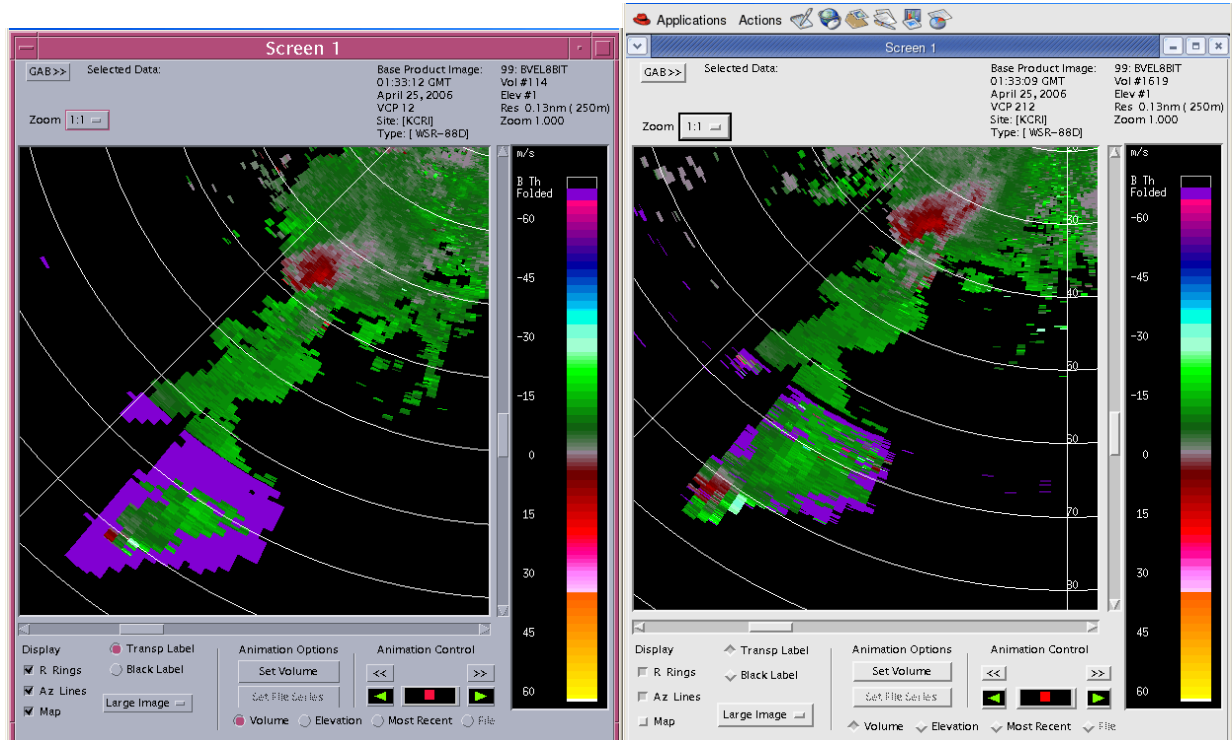
Send comments/questions on this update to [Tim.D.Crum@noaa.gov](mailto:Tim.D.Crum@noaa.gov).



VCP 11

VCP 211

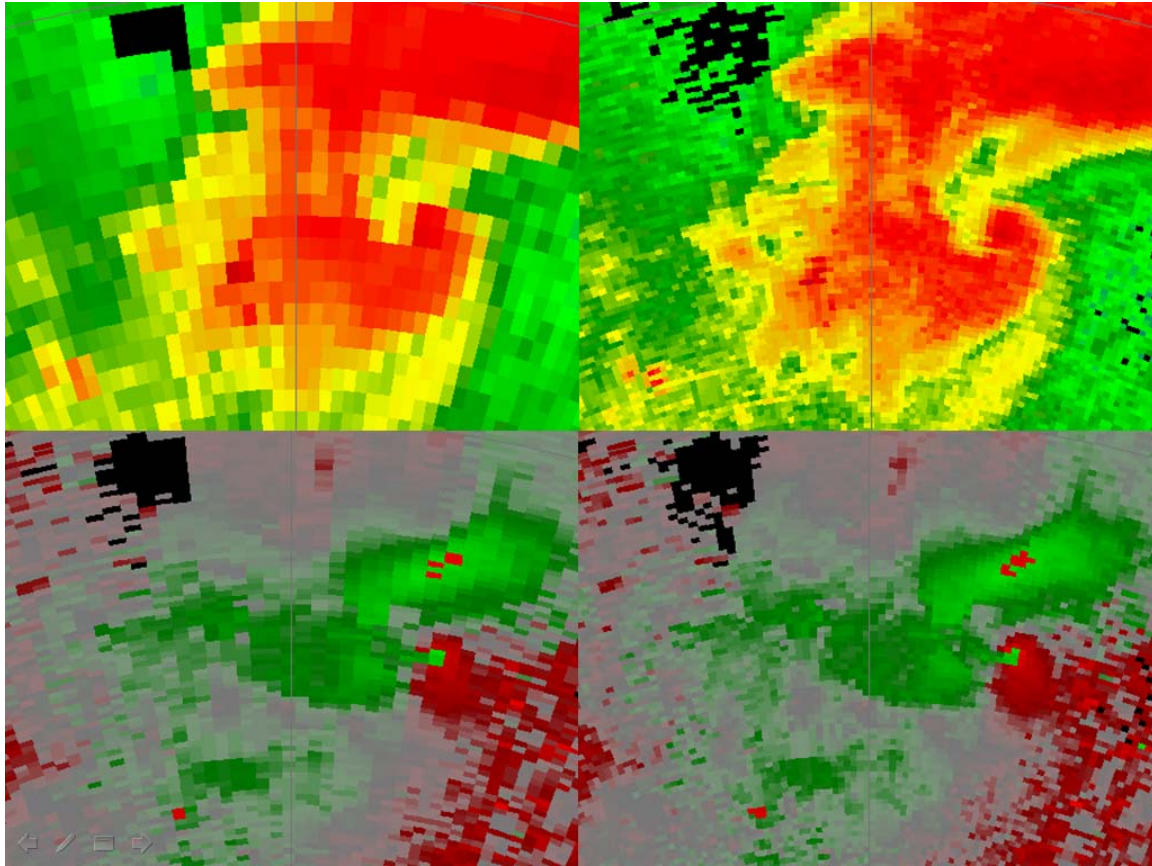
Figure 1. Example of the reduction in range folded radial velocity data using the SZ-2 algorithm in VCP 211 (right) in comparison with the legacy VCP 11 (left). These data were collected on KCRJ, the test WSR-88D in Norman, Oklahoma on consecutive scans at  $0.5^\circ$  elevation. The range folded data is indicated by the areas of purple coloring.



VCP 12

VCP 212

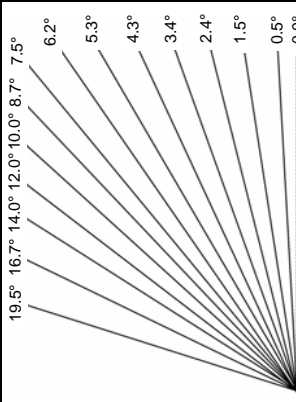
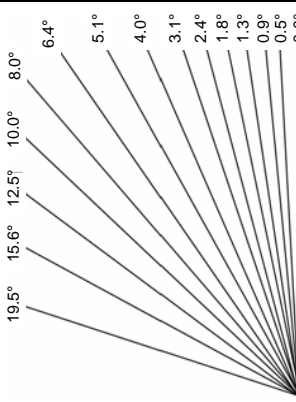
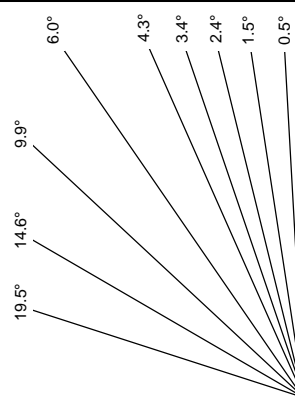
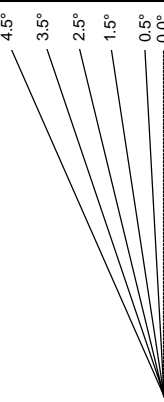
Figure 2. Example of the reduction in range folded radial velocity data using the SZ-2 algorithm in VCP 212 (right) in comparison with the legacy VCP 12 (left). The VCP212/SZ-2 data at the  $0.5^\circ$  elevation was collected by KCRJ (the test WSR-88D) in Norman, Oklahoma. The VCP12 data at the  $0.5^\circ$  elevation was collected at nearly the same time on the KTLX WSR-88D at Twin Lakes, Oklahoma.



Legacy Resolution

Super Resolution

Figure 3. This figure provides an example of the differences between “Legacy” and “Super Resolution” WSR-88D Level II data. The two left panels have the Legacy resolution data (1 km gate spacing for reflectivity data, 250 m gate spacing for radial velocity data and 1° azimuth/angular resolution). The images to the right show the same situation, but viewed with Super Resolution data (250 m gate spacing for reflectivity and radial velocity data and a 0.5° azimuth/angular resolution). The tornado signature is more readily apparent using the Super Resolution data.

Quick Reference VCP Comparison Table for RPG Operators						February 2007
Slices		Tilts	VCP	Time*	Usage	Limitations
	14	11	5 mins	Severe and non-severe convective events. Local 11 has Rmax=80nm. Remote 11 has Rmax=94nm.	Fewer low elevation angles make this VCP less effective for long-range detection of storm features when compared to VCPs 12 and 212.	
		211	5 mins	Widespread precipitation events with embedded, severe convective activity (e.g. MCS, hurricane). Significantly reduces range-obscured V/SW data when compared to VCP 11.	All Bins clutter suppression is NOT recommended. PRFs are not editable for SZ-2 (Split Cut) tilts.	
	14	12	4 1/2 mins	Rapidly evolving, severe convective events. Extra low elevation angles increase low-level vertical resolution when compared to VCP 11.	High antenna rotation rates decrease the effectiveness of clutter filtering, increase the likelihood of bias, and slightly decrease accuracy of the base data estimates.	
		212	4½ mins	Rapidly evolving, widespread severe convective events (e.g. squall line, MCS). Increased low-level vertical resolution compared to VCP 11. Significantly reduces range-obscured V/SW data when compared to VCP 12.	All Bins clutter suppression is NOT recommended. PRFs are not editable for SZ-2 (Split Cut) tilts. High antenna rotation rates decrease the effectiveness of clutter filtering, increase the likelihood of bias, and slightly decrease accuracy of the base data estimates.	
	9	21	6 mins	Non-severe convective precipitation events. Local 21 has Rmax=80nm. Remote 21 has Rmax=94nm.	Gaps in coverage above 5°.	
		121	6 mins	VCP of choice for hurricanes. Widespread stratiform precipitation events. Significantly reduces range-obscured V/SW data when compared to VCP 21.	PRFs are not editable for any tilt. Gaps in coverage above 5°.	
		221	6 mins	Widespread precipitation events with embedded, possibly severe convective activity (e.g. MCS, hurricane). Further reduces range-obscured V/SW data when compared to VCP 121.	All Bins clutter suppression is NOT recommended. PRFs are not editable for SZ-2 (Split Cut) tilts. Gaps in coverage above 5°.	
	5	31	10 mins	Clear-air, snow, and light stratiform precipitation. Best sensitivity. Detailed boundary layer structure often evident.	Susceptible to velocity dealiasing failures. No coverage above 5°. Rapidly developing convective echoes aloft might be missed.	
		32	10 mins	Clear-air, snow, and light stratiform precipitation.	No coverage above 5°. Rapidly developing convective echoes aloft might be missed.	

\*VCP update times are approximate.